

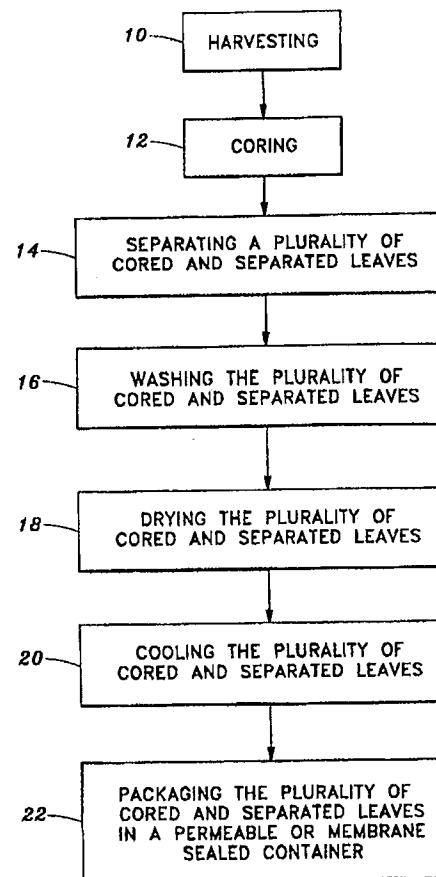
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(71)(72) Applicants and Inventors: WOLFE, Steven, K. [US/US]; 116 Osprey Lane, Aptos, CA 95003 (US). TANI, Michael, Y. [US/US]; 2225 Skyway Drive, Santa Maria, CA 93455 (US).			
(74) Agent: HALL, Jeffrey, A.; 212 Clinton Street, Santa Cruz, CA 95062 (US).			

## (54) Title: METHOD FOR CLEANING, PACKING, AND TRANSPORTING VEGETABLES

## (57) Abstract

A method for processing common headed varieties of vegetables such as iceberg lettuce so as to remove all dirt, insects, and other debris from the vegetable and to allow shipping and transport of the vegetable while preserving the characteristics and versatility of the vegetable in a fresh form. The method comprises harvesting (10) the vegetable at or near maturity and then coring the vegetable (12). A plurality of cored and separated leaves are then washed and dried (16). The plurality of cored and separated leaves are maintained in a cool environment, preferably from 32 to 55 degrees F. The cored and separated leaves are then packaged (22) in a permeable film or membrane sealed container allowing for the interchange of atmospheric gasses and gasses from the interior of the film or container.



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## Description

### Method for Cleaning, Packing, and Transporting Vegetables

#### Technical Field

5 This invention relates to methods for packing, storing, and transporting vegetables headed varieties of vegetables, and particularly to methods for packing, storing, preserving, and transporting headed vegetables such as iceberg lettuce.

#### Background Art

10 Various methods and apparatuses have been proposed and implemented to effect the packing, storing, and transport of headed varieties of vegetables. Since the advent of commercially successful modified atmosphere packages for leafy greens in the later 1970's, the domestic market for fresh-cut packaged produce has exploded to a \$650 million dollar per year industry. The convenience of prepared leafy salad products has 15 been firmly established and all indicators point to further growth. Prior to the present invention, however, it has been only possible to provide tightly headed varieties of salad vegetables such as iceberg lettuce in chopped or shredded form. The lack of a means to provide larger pieces of head lettuces has prevented introduction of such produce due to phytosanitary conditions. The present invention enables the introduction of such produce 20 and provides consumers with valuable alternatives to currently available produce.

The export market has, for many years, been an attractive one for growers and shippers of fresh fruits and vegetables. However, due to phytosanitary conditions within certain foreign markets, for example, Japan, exports have been limited in both type and amount of produce exported. A particular concern in the produce export arena 25 is that many fruits and vegetables are prone to insect infestation, such as aphids, which subject the produce to rejection at the port of entry. The presence of one live aphid in a load of one-thousand cartons (which hold from 24,000 to 38,000 heads of lettuce, for example) can cause the rejection of the entire load. Nevertheless, demand for lettuce among Japanese and other consumers is high and growing.

30 For some time, a limited amount of fumigated lettuce product has been successfully exported to Japan alongside washed, precut products such as chopped and

shredded lettuce. However, the demand is for the whole forms and the flexibility in preparation it allows. Heretofore, while methods have been proposed for the preparation of leafy green vegetables, it is not satisfactory for a tightly heading vegetable such as iceberg lettuce. The present invention allows for the fulfillment of a significant demand 5 through the versatility offered by enabling the shipping of the whole head and larger leaves of these much desired lettuce varieties.

The reason why the seemingly simple process of packaging and distribution of fresh vegetables has been difficult is that there are in fact significant technical obstacles which prior methods have failed to solve. Fresh fruit and vegetables continue to respire 10 after harvest. Post harvest respiration involves the metabolic conversion of oxygen to carbon dioxide by the produce and frequently, a concomitant release of ethylene. Ethylene is a plant hormone which usually enhances metabolic rate and is used commercially for accelerating the ripening of several crops, for example, bananas and tomatoes.

15 Excess ethylene in headed green vegetables can cause rapid senescence and spotting which is undesirable. Excess oxygen can cause deleterious oxidative processes to occur that the harvested plant is not capable of combating. For example, phenoloxidase-catalyzed reactions can lead to "pinking" off the white rib tissue in iceberg lettuce and to similar darkening and discoloration of cut and/or injured tissue. 20 Carbon dioxide is also a significant problem for it is continually produced throughout the senescence of the plant and packaging of the produce allows for a buildup of carbon dioxide within the packaging or the container which may result in significant discoloration.

Further, in a closed environment, consumption of oxygen and production of 25 carbon dioxide can rapidly progress to the stage where oxygen is less than one percent. Near, and below this point, respiratory processes traverse a different reaction pathway, namely via anaerobic processes. Such anaerobic processes result in partial oxygenated decay products such as aldehydes and ketones which may cause off flavors and aromas in the produce. Anaerobic conditions may also result in the growth of harmful anaerobic 30 microbiological organisms.

All of the aforementioned factors are influenced by temperature, with deleterious results occurring more rapidly at higher temperatures. Moreover, the requirement for sanitation, temperature control, and effective processing techniques which minimize tissue damage and packaging technology that will allow for sanitary packaging while

allowing the proper flow of atmospheric and respiratory gases, creates a complex system with varying specific requirements depending upon the particular fruit or vegetable being handled and the end requirements.

5        Although a large variety of packing, storing, and transport methods have been developed for agricultural products, there exists significant problems and limitations with all such methods, and particularly when applied to the shipping and handling of headed varieties of vegetables such as lettuce. This has undoubtedly been a reason for the significant restrictions and problems limiting the export of such produce.

10      Accordingly, it is the primary object of this invention to provide a method for cleaning, packing, and transporting headed varieties of vegetables which allows such vegetables to be harvested, cleaned, packaged, and shipped while preserving all of the critical and important characteristics of such headed vegetables while guaranteeing them to be free of insects or other infestation and debris, and which is inexpensive to apply and highly efficient in results.

15      Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the methods and combinations particularly pointed out in the appended claims.

20

### **Disclosure Of Invention**

25      The present invention provides a method for harvesting, cleaning, and packaging headed varieties of vegetables such as cabbage, iceberg lettuce, raddichio, and other produce, allowing for the cleaning, packing, and transport of such leafy vegetables while preserving all of the critical and desired characteristics and guaranteeing that such produce be free of insects or other infestations and debris.

30      To achieve the foregoing objects, and in accordance with the purpose of the invention as embodied and broadly described herein, a method for cleaning, processing, packing, and storing headed varieties of vegetables is provided, comprising: harvesting the headed leafy vegetable at or near maturity; coring the leafy vegetable and then separating a plurality of cored and separated leaves from the leafy vegetable. The cored and separated leaves are then washed so as to remove dirt, insects, and other debris

from the cored and separated leaves. The cored and separated leaves are then dried and cooled. The cored and separated leaves are then packaged in a permeable or membrane sealed container allowing for an interchange of atmospheric and interior gases.

The method of the present invention is preferably used with headed leafy  
5 vegetables such as lettuce, including iceberg lettuce and other headed leafy vegetables such as raddichio, and cabbage. However, in alternative applications the method of the present invention may be applied for use with other vegetables and fruits. In fact, the particular application is dependent only upon the requirements of the user as a wide range of headed vegetables could be cleaned, packaged, and transported using the  
10 methodology described herein.

In accordance with the present invention there also is provided an improved method of cleaning, processing, packaging, and storing iceberg lettuce, comprising: harvesting said lettuce at or near maturity; coring the lettuce; separating a plurality of cored and separated leaves from the lettuce; washing the plurality of cored and separated leaves; drying the plurality of cored and separated leaves; cooling the plurality of cored and separated leaves; and packaging the plurality of cored and separated leaves in a permeable film or membrane sealed container allowing for the interchange of atmospheric and interior gases.  
15

## 20 Brief Description of Drawings

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate a preferred embodiment of the invention and, together with a general description given above and the detailed description of the preferred embodiment given below, serve to explain the principles of the invention.

25 Fig. 1 is a flow chart of the method for cleaning, packing, and transporting headed vegetables varieties, according to the invention.

## Best Mode For Carrying Out The Invention

Reference will now be made in detail to the present preferred embodiments of  
30 the invention as illustrated in the accompanying drawings.

In accordance with the present invention, there is provided a method for cleaning, processing, packing, and storing headed varieties of vegetables, comprising: harvesting the headed leafy vegetable at or near maturity; coring the leafy vegetable; separating a plurality of cored and separated leaves from the leafy vegetable; washing 5 said plurality of cored and separated leaves so as to remove dirt, insects, and other debris off the cored and separated leaves; drying said plurality of cored and separated leaves; cooling said plurality of cored and separated leaves; and packaging said plurality of cored and separated leaves in a permeable or membrane sealed container allowing for an interchange of atmospheric and interior gasses.

10 There is also provided, in accordance with the invention a method of cleaning, processing, packaging, and storing lettuce, or *Lactuca sativa*, including varieties as iceberg lettuce, comprising: harvesting said lettuce at or near maturity; coring the lettuce; separating a plurality of cored and separated leaves from the lettuce; washing said plurality of cored and separated leaves; drying said plurality of cored and separated 15 leaves; cooling the plurality of cored and separated leaves; and packaging the plurality of cored and separated leaves in a permeable film or membrane sealed container allowing for the interchange of atmospheric and interior gases.

In Fig. 1, a flow diagram is shown outlining the steps the method of the present invention. In step 10 the lettuce or other produce is harvested at, or near maturity, 20 preferably 5-7 days prior to the normal time of harvest when lettuce, such as iceberg lettuce, is somewhat loose in internal structure which facilitates the separation of the leaves without damage to the leaves. The lettuce or other produce may be harvested into standard containers such as cartons, totes, or bins, with re-usable totes or bins being preferred.

25 As seen in step 12, the lettuce or other produce is then cored either manually or using mechanical means which may include mechanical cutters, corers, or the like. Next, as seen in step 14, a plurality of cored and separated leaves are separated from the headed vegetable or other produce so as to remove dirt, debris, insects and other infestations. Preferably the leaves are separated under water with a low pressure flow of 30 water. It is essential to core the lettuce or other produce in order to produce a product which may be cleaned and inspected and which has all of the key characteristics of the vegetable or other produce while guaranteeing it to be free of insects or other infestation and debris.

The plurality of cored and separated leaves is then washed with water as shown

in step 16. Chlorine or other disinfectants may be added to the water if desired. If chlorine is used solutions ranging from 10 to 1000 parts per million of chlorine to water are preferred. The washing step removes dirt, debris, insects and other infestations from the leaves. In step 20 it is seen that the plurality of cored and separated leaves are cooled. However, cooling may occur prior to any of the aforementioned steps. The leaves may be sorted for size, color or other characteristic at any point in the method.

5 The plurality of cored and separated leaves are then packaged in a permeable film or membrane-sealed container that will allow sufficient, but not excessive, interchange of atmospheric and interior gases. The films may be high density, mid-density, or low density breathable polyethylene for example, or other non-surface adhering thermoplastics may be utilized such as linear low density polyethylene, polypropylene, polystyrene, biaxially oriented polypropylene, vinyl acetate copolymers, polyvinyl chloride, mixtures or the foregoing, multilayer films of the foregoing, and other 10 polymers and copolymers. A critical characteristic of any film or membrane used is that it permits the sufficient but not excessive interchange of atmospheric and interior gases.

15 Preferably, proper cooling and subsequent temperature control are maintained from initial onset of cooling throughout the distribution chain of the produce. In most cases, the preferred temperature range will be from about 32-55 degrees F. Such 20 cooling may be effected by any of a number of means well known in the art such as vacuum cooling or exposing the produce to cool air. Alternatively, hydro-cooling using chilled water may also be effective, and may be implemented in the washing step 16 if desired.

25 In operation and use the method of the present invention is highly efficient, cost effective, and easy to implement. The method of the present invention may be implemented in a produce room, packing house, or any other suitable building or location. Alternatively, the method of the present invention may be effected on a portable harvesting machine that operates directly in the field. The method of the present invention as herein described may be used with headed varieties of vegetable, however, 30 it is most conveniently used with vegetables such as lettuce, particularly head lettuce such as iceberg lettuce thereby allowing for the year-round supply of fresh supply of produce to both domestic and international consumers with all of the key and critical characteristics preserved while guaranteeing the produce to be free of insects or other infestations, dirt, and debris.

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Additional advantages and modification will readily occur to those skilled in the art. The invention in its broader aspects is, therefore, not limited to the specific details, representative apparatus and illustrative examples shown and described. Accordingly, departures from such details may be made without departing from the spirit or scope of  
5 the applicant's general inventive concept.

## Claims

1. A method for cleaning, processing, packing, and storing headed varieties of leafy vegetables while preserving all of the critical and important characteristics of such headed varieties of leafy vegetables, comprising:
  - 5 harvesting the headed variety of leafy vegetable at or near maturity;
  - coring the headed variety of leafy vegetable;
  - separating a plurality of cored and separated leaves from the headed variety of leafy vegetable;
  - 10 washing said plurality of cored and separated leaves so as to remove dirt, insects, and other debris off the cored and separated leaves;
  - drying said plurality of cored and separated leaves;
  - cooling said plurality of cored and separated leaves; and
  - 15 packaging said plurality of cored and separated leaves in a permeable or membrane sealed container allowing for an interchange of atmospheric and interior gasses.
2. The method of claim 1, wherein said headed variety of leafy vegetable is iceberg lettuce.
3. The method of claim 1, wherein said headed variety of leafy vegetable is raddichio lettuce.
- 20 4. The method of claim 1, wherein said coring is achieved by manual methods.
5. The method of claim 1, wherein said coring is achieved by mechanical methods.
6. The method of claim 3, wherein said packaging of said plurality of cored and separated leaves comprises packaging a single lettuce equivalent in a single package.
- 25 7. A method of cleaning, processing, packaging, and storing lettuce while preserving all of the critical and important characteristics of the lettuce, comprising:

- 9 -

- harvesting said lettuce at or near maturity;
- coring the lettuce;
- separating a plurality of cored and separated leaves from the lettuce;
- washing said plurality of cored and separated leaves;
- 5       drying said plurality of cored and separated leaves;
- cooling the plurality of cored and separated leaves; and
- packaging the plurality of cored and separated leaves in a permeable film or membrane sealed container allowing for the interchange of atmospheric and interior gasses.
- 10      8. The method of claim 7, wherein said lettuce comprises iceberg lettuce.
9.       The method of claim 7, wherein said coring is achieved by manual means.
10.      The method of claim 7, wherein said coring is achieved by mechanical methods.
11.      The method of claim 9, wherein said packaging of said plurality of cored and separated leaves comprises packaging a single lettuce head in a single package.

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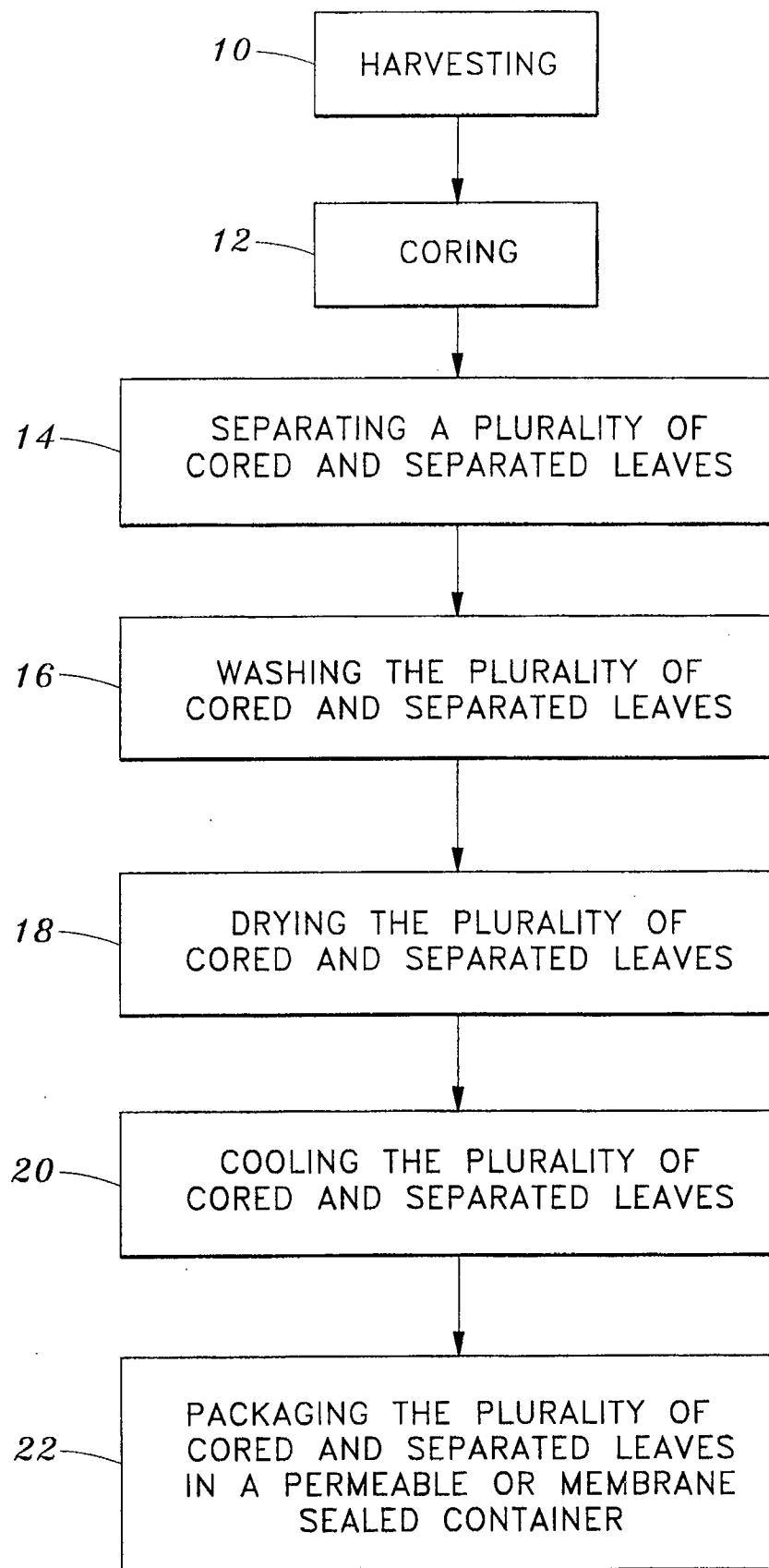


Fig. 1

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US96/03237

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : A23L 1/212; A23B 7/00; B65B 25/04

US CL : 426/415, 419

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 426/324, 415, 419

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 5,316,778 (HOUGHAM) 31 MAY 1994, See entire document.	1-11
Y	WO, A, 94/15475 (WU) 21 JULY 1994, See entire document.	1-11
Y	US, A, 3,450,543 (BADRAN ET AL) 17 JUNE 1969, See entire document.	1-11
Y	US, A, 3,795,749 (CUMMIN ET AL) 05 MARCH 1974, See entire document.	1-11
Y	US, A, 5,046,304 (ALAMEDA ET AL) 10 SEPTEMBER 1991, See entire document.	1-11
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**INTERNATIONAL SEARCH REPORT**International application No.  
PCT/US96/03237**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,001,443 (DAVE) 04 JANUARY 1977, See entire document.	1-11